NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
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# Meeting of the Bering Sea and Aleutian Islands Groundfish Plan Team

Plan Team Report

November 13-17, 2023

**BSAI Groundfish Plan Team Members**:

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| Steve Barbeaux | AFSC REFM (co-chair) | Kirstin Holsman | AFSC REFM |
| Kalei Shotwell | AFSC REFM (co-chair) | Phil Joy | ADF&G |
| Cindy Tribuzio | AFSC ABL (vice chair) | Andy Kingham | AFSC FMA |
| Diana Stram | NPFMC (coordinator) | Beth Matta | AFSC REFM |
| Lukas DeFilippo | AFSC ABL | Andrew Seitz | UAF |
| Allan Hicks | IPHC | Jane Sullivan | AFSC ABL |
| Lisa Hillier | WDFW | Steven Whitney | NMFS AKRO |

## Introduction

The meeting for the BSAI Groundfish Plan Team ("Team") began on Monday, November 13, 2023 at 1:00 pm PST at the AFSC. Participation was both in person and offered remotely via Zoom. Roughly 30 people attended the meeting in person, with many more signed in remotely, but attendance varied throughout the meeting. All documents and presentations were posted to the Teams' electronic agenda. All presentations are also linked in the header for each agenda item in this report.

*Future meetings*: Dates for 2024 meetings are: January 17th (virtual only; Research Priorities), September 17-20th, November 12-15th.

## General recommendations on Stock Assessments

Stock Assessment Appendices: **The Team recommended as a best practice that appendices be linked in the front of the document (as with the sablefish assessment) to allow for an easier review of the appendices.**

## BSAI Ecosystem Status Report (ESR)

Ivonne Ortiz presented the Ecosystem Status Report for the Aleutian Islands and highlighted major concerns and changes. There have been sustained warmer temperatures for the last 10 years and the past winter saw the warmest sea surface temperatures on record. A thermal regime shift in North Pacific mean sea surface temperatures has been documented in 2013/2014. There has also been less fish in Pacific cod diets resulting in worse fish condition as a result of decreased diet quality and potentially higher bioenergetic costs. While prey consumption and fish condition increased in 2022, it is still below the 1986-2022 time series mean. Furthermore, there was less mixing and transport of heat, salt and nutrients through Aleutian passes. There was lower than average spring phytoplankton biomass this year, and smaller copepod size than last year, but zooplankton appeared to be in better condition. Seabirds demonstrated mixed performance in the western Aleutian Islands and average or above average in the Eastern Aleutian Islands. Harmful algal blooms are more prevalent than last year, but below the maximum observed in 2020. Pink salmon abundance has been record high in odd years and high in even

years while there has been a shift in pelagic foragers from Atka mackerel and walleye pollock to Pacific ocean perch and northern rockfish. The shift means longer mean lifespan in the groundfish community and a slower turnover rate.

The Team asked if the dietary switch observed in Pacific cod was also observed in rockfish or Atka mackerel diets and were told that the analysis has not been done for Pacific ocean perch or Atka mackerel and there is a need to collect stomachs for northern rockfish. The Team also inquired whether the cod dietary information would be a regular part of future ecosystem reports and were informed that it would be (with a one year lag), provided that the AFSC has the staff to process samples.

Elizabeth Siddon presented the Eastern Bering Sea Ecosystem Status Report which was separated out into the Northern and Southeastern Bering Sea in response to an SSC request. The report examined quantitative linkages between items in the Report Card using a dynamic structural equation model to determine how different aspects of the ecosystem interact with each other. In response to a question, the Team was told that independently specified lags were part of the model. There was also a question about whether all indicators were included in the model given that some covary. The Team was told that all variables except the North Pacific Index are included in the model. The approach remains a work in progress as some relationships did not make intuitive sense and the results are driving further research. There was also discussion about how to deal with guilds versus species-specific information.

The Southeastern Bering Sea has cooled relative to the recent warm stanza but remains warmer than average. The cold pool extent was average and similar to 2022 while annual sea ice extent increased but remains similar to low ice years prior to 2010. Although things have cooled, biological systems have not recovered from the recent warm stanza. Primary productivity remains poor, secondary productivity was moderate to low, integrated measures of pelagic productivity were mixed and benthic productivity largely showed declines.

The Northern Bering Sea also transitioned to more average conditions with different biological responses than the Southeastern Bering Sea. Primary production was low, secondary production was higher (euphausiids in particular), pelagic productivity was mixed, and benthic productivity largely showed declines. There was an extended presentation of Yukon and Kuskokwim chum salmon declines using both western science and traditional ecological knowledge with the help of Terese Vicente from the Kuskokwim River Inter-Tribal Fish Commission.

A member of the public questioned the trends of sponge abundance in the trawl survey given that the amount of variation seen in the time series is unlikely for a long-lived immobile invertebrate. The Team was told that much of the variability was likely due to changes in catchability over time since the survey is not designed to assess invertebrate abundance. The Team had a conversation about utilizing random effects models to deal with process error in the indicator and standardizing the index for variables such as bottom contact time.

There was a question from the public about whether there was a policy about external, non-government entities presenting to the Plan Teams and providing data for the ecosystems report and suggested that additional members of industry had a lot of knowledge about ecosystem trends that they could contribute. The Team responded that there was no policy per se only that a contribution that is reviewed and included in the ESR based upon the applicability of the information for relevant ecosystem processes may be presented to the Plan Teams.

The public also questioned the findings of low condition in pollock and stated that they are not seeing the same trend. Jim Ianelli addressed these concerns and stated that he saw similar low condition trends in the survey and the fishery but that there is much more data from the fishery. It was noted that pollock

demonstrated lower condition in the northern Bering Sea relative to the south and that changes in the fleet distribution could partially explain the observed lower condition in pollock.

Lastly there was a question regarding how coccolithophore blooms affect benthic communities through sedimentation processes. The contributors cover pelagic impacts but thus far have not reported on benthic affects. The presenter agreed to follow up on this question with contributors.

## EBS pollock (Operational Full)

Jim Ianelli presented the annual operational full stock assessment for Eastern Bering Sea (EBS) pollock. The Team appreciated the quality of the work, in-depth analysis, and clear presentation provided by the EBS pollock assessment team. Changes to the assessment, compared to the 2022 assessment, included refined estimate of weight-at-age data used to compute spawning biomass and an updated time-series of acoustic data collected from the bottom trawl survey (acoustic vessel of opportunity, AVO), which accounts for process and observation error. The changes were reviewed at the September Plan Team meeting. The author independently calculated fish condition (based on mean weight across time for a given length) and noted that fish condition was the lowest in the time series (i.e., fish were much lighter/thinner for a given length than has been seen before). However, the annually-varying weight-at-age method in the model helps account for the lower fish condition and is reflected in the updated weight-at-age estimates resulting in the largest change to estimates, which are the primary driver of the change in the time series of spawning biomass compared to the previous assessment. The Team also appreciated the rapid ageing of 2023 survey ages that were used in this assessment. Stock structure is consistent with recent genetic analyses. Bycatch rates remain low, especially relative to other fisheries. Overall, the improvements to the assessment were useful and fits looked good, but the author noted a persistent but acceptable positive retrospective pattern in spawning biomass.

Although the cold pool was near average in 2023, it was closer inshore than had been observed in previous average years. The Team would appreciate a figure showing the distribution of pollock in relation to the cold pool. It was noted that fewer pollock were in the northern Bering Sea and generally there was an avoidance of the cold pool historically, but in 2022 and 2023 this was not the case, with large numbers of pollock occurring within the cold pool region. Discussions among Team members and AFSC staff highlighted that 2022 and 2023 were colder years but were near average conditions considering the entire time-series. There was discussion regarding how they were different from past cold years, with lagged recovery of ecosystem productivity and low prey quality and quantity. These factors might be influencing the low condition factor for pollock (well below average weight-at-age) and divergent distributions relative to those expected from a near average cold pool extent. The Team and ESR authors noted that although the system has cooled, the expected biological response has not occurred and there may be persistent lags in response and ecological recovery. The Team was interested in learning more about the estimates of the cold pool coefficient in the VAST model and whether that covariate value had changed in the updated index.

More than 50% of the 2022 fishery catches were from the large 2018 year-class and the population age diversity is nearly the lowest since 1980. The spawning biomass diversity increased slightly, but with more of the 2018 year-class maturing, this may decrease in the future. The Team discussed whether this heavy reliance on the 2018 year-class is a concern. A large proportion of the spawning biomass being one year class may reduce genetic diversity, but it is not certain how that affects the sustainability of the EBS pollock stock. The 2018 year-class is estimated to be one of the largest in the time-series and the spawning biomass is generally large; this may reduce the concern of a low diversity index. Furthermore, there is the possibility that weight-at-age could be positively biased for the 2018 year-class and will change from an average weight-at-age when it was young to a negative weight-at-age residual as it ages. This has been seen with other large year classes, such as 2008 and 2013, and may be a reason for the

retrospective pattern on spawning biomass. There are many reasons for a change in the weight-at-age residual over time including density-dependence and where the fleet is fishing.

The Team appreciated the presentation of MCMC posterior distributions and posterior predictive distributions. These appear to be useful, and the Team looks forward to insights from the authors on how to best interpret these for this assessment.

Projections using 1,350 kt for 2024 and 2025, and then the recommended ABCs afterwards or ABCs more consistent with recent catches were useful to understand the trade-offs between catch and catch stability. Higher ABCs after 2025 result in a rapid decrease in spawning biomass followed by rapid decreases in catch. ABCs consistent with recent catches result in an increase in spawning biomass and stable catches.

There was discussion with industry representatives about the reduction in ABC and market forces on fishing effort. Members of the public indicated that they were pleased with the quality of this assessment and there is concern that determining an ABC from Tier 3 calculations reduces the overall quality and usefulness. They are curious if level 1 for all risk table elements would result in the ABC set equal to the maxABC (from Tier 1). Industry was concerned about using fishing effort to describe fishing effects because fishing effort in the industry is a factor of the markets and there is little linkage between effort and biology or the population size. Examples also include avoiding bycatch. The Team, authors, and public discussed the differences between effort on a smaller scale such as individuals or companies vs. the force of fishing on a fleet-wide basis as used in the stock assessment. There are expectations of approximately what the stock assessment force of fishing should be, realizing that fishery dynamics are very complex and fishery behavior may drive patterns in the data such as weight-at-age.

When asked if there were thoughts on how to deal with the retrospective patterns, the authors suggested that these types of models are not as good at predicting increases compared to predicting decreases and more precise data on how fast the stock is increasing would be useful. The Team appreciated the retrospective plots, including the evolution of year-classes and retrospective selectivity plots, and the Team looks forward to improvements that were mentioned for the future. There was a concern that when a cohort is around 5 years old, the selectivity used in the projection has often been above subsequent estimates (i.e., the outcome being that the projection frequently overestimates biomass, potentially leading to the positive retrospective bias noted earlier). Future improvements based on current research include potentially using an autoregressive method to help constrain projections of selectivity and address the selectivity bias. The Team supports these research directions.

Selectivity varies over time, thus a decision must be made regarding what selectivity pattern to use in the projections. It was unclear in the assessment document (Section 6.1 and Section 7.4) how the selectivity for 2024 was determined. The Team appreciated the analyses done to show the effect of selectivity assumptions in the projections and would appreciate a clear description of the selectivity pattern used in the projections. When asked, the authors said a recent 5-year average of selectivity was used.

The Team agreed with the author on the recommended model, Model 23.0 that is a Tier 1a designation, and the recommended reduced ABC determined using a Tier 3 calculation. A reduction in the ABC is warranted due to multiple environmental concerns highlighted in the ESR. Examples include reduced primary production, indicators for reduced secondary productivity and reduced prey quality and quantity as supported by indicators in the pelagic environment such as lipid content and energy density, as well as concerns for indirect metrics such as seabird indicators. There were multiple indicators of concern from both bottom-up and top-down views. Additionally, even though population risk level was assigned a value of 1, there are concerns about recruitment and retrospective patterns in the estimation of large year-classes. The 2018 year-class is currently at the age where it may be estimated with a positive bias.

- **The Team recommended continuing to evaluate projection bias due to selectivity assumptions, and the examination of new methods that may reduce that bias**.
- **The Team recommended that the authors clearly state where MLE estimates are being used and where MCMC estimates are being used.** For example, MLE estimates are used to determine $F_{OFL}$, which was unclear given the presentation of the posterior distribution for $F_{OFL}$. The Team appreciated the posterior distributions and presentation of them for comparison. The authors noted that they have some concern about using posterior distributions for the determination of the ABC. The Team looks forward to learning more about these concerns and how the two types of output fit within the NPFMC Tier system.
- **The Team recommended using posterior distributions from the MCMC to determine probabilities in the risk table and expanding the risk table to at least include the recommended ABC.** It may be useful to identify thresholds of interest that are desired to remain above or not exceed, and how these relate to risk deliberations and ABC reductions. Some of these thresholds may be small probabilities which require accurate characterization of the tails of the distribution.

## ESP for Bering Sea cod

Kalei Shotwell presented the eastern Bering Sea Pacific cod ESP. Ecosystem indicators were reported as approaching or slightly above average conditions in 2023, reflecting continued improvements in ecosystem indicators for Pacific cod (e.g. temperature, food availability) relative to the warm years of 2016-2020. Socioeconomic indicators for 2023 somewhat reversed the recent declining trends noted in the previous ESP to near average conditions. The importance test (using Bayesian adaptive sampling method) identified summer bottom temperature as the most important covariate for recruitment in 2023. This is a change from the previous ESP, which identified spring surface temperature as the most important covariate, which aligns more closely with the CEATTLE model analyses. The author recognized this, noting the poor fit to recruitment, and commented on an ongoing research project to develop a method of incorporating multiple covariates into an alternative importance test method.

Results of an advanced test integrating the CEATTLE model and the most recent Pacific cod stock assessment indicate predation mortality for age -1 Pacific cod decreased to below average this year, biomass of Pacific cod consumed by predators increased to above average, and the ration (adults age 4+) decreased but is still above average. The authors plan to continue exploring this alternative method of advanced testing using the multi-species model outputs and hope to also identify new ways to use the CEATTLE model in the ESP. They also plan to evaluate the results of an upcoming request for additional indicators (planned for 2024) to determine how to integrate them into the ESP, and to re-evaluate the socioeconomic indicators used in the ESP.

The Team appreciated the ESP briefing, finding it useful for setting context prior to the full assessment presentation.

## Eastern Bering Sea Pacific cod (Operational Full)

Steve Barbeaux presented the operational full assessment for eastern Bering Sea Pacific cod. Stand-alone models were brought forward to replace the previously accepted ensemble of models. The four models from the previous ensemble were integrated, and three additional models were presented.

- Models 22.1, 22.2, 22.3, and 22.4 make up the 2022 accepted ensemble.
- Model 23.1.0a is a simplification of 22.2 with no annually varying parameters, multinomial likelihood for all compositional data instead of the Dirichlet-multinomial, and bootstrapped input sample sizes for composition data; natural mortality is still estimated in this model.
- Model 23.1.0d is the author recommended model and is model 23.1.0a with fixed natural mortality, annually varying growth ($L_{min}$ and Richard's rho), annual varying survey selectivity, and a time block on fishery selectivity starting after 1990.
- Model 23.2 is model 23.1.0.d with survey conditional age-at-length data instead of survey marginal age compositions.

The time-block of time-varying fishery selectivity was a new feature not seen at the September presentation but was implemented to address concerns of the Team regarding the influence of fishery length compositions.

Length observations (with weights) from the state fisheries were provided for 2023 and typically showed smaller fish than seen in the observer data. The authors will investigate whether otoliths are available. This was the first year these data were available, and it will be useful to obtain similar data in the future to continue looking at these comparisons. These data were greatly appreciated and provide important insights into the state fisheries.

The EBS shelf trawl survey index increased, which is used in the assessment, but fishery CPUE and the longline survey indices both decreased and are not used in the assessment. The authors noted that the EBS shelf trawl survey index is in numbers, but the EBS shelf trawl survey biomass index declined. Industry and Team members provided insights into the longline survey and fishery CPUE. It was a member of the public's opinion that the longline survey may not be a reliable indicator of Pacific cod biomass because this survey fishes in deeper water than the fishery, catches larger fish, and is not comprehensive as it does not cover the area where the main fishery occurs. Fishery CPUE has decreased but is near average. Comments from industry indicated that they expected a decline in CPUE in 2023, are not concerned about this decline, and that management has a large effect on fishery CPUE. In particular, closing of the EBS area forces the fleet to fish in the EBS first, and then the AI later when fishing is less desirable in the AI. It was noted that there are plans for a postdoctoral researcher to conduct an in-depth analysis of fishery CPUE, which was supported by the Team. Similar comments were made by the authors in the Fishery Performance section of the Risk Table.

Model 23.2 used conditional age-at-length data instead of marginal age compositions. A member of the public asked for more information on the effect of this model on assessment outputs. Model 23.2 was less stable and needs additional work, including data weighting. This model is sensitive to input sample sizes and the authors are working on a routine to determine these.

The Team applauds the authors for the improvements to the assessment model and agrees with the authors' recommended model (23.1.0.d) and ABC. It was useful to examine a single model at this time, and many aspects of the assessment were improved. For example, all models in the 2022 ensemble resulted in low convergence rates in jitter tests, whereas the 2023 models had high convergence rates, and retrospective patterns are greatly improved. However, accepting a single model now does not preclude using an ensemble in the future to capture structural uncertainty.

A number of outcomes resulting from the new model with fixed *M* were mentioned: elevated recruitment levels, an increase in $F_{OFL}$, and changes to selectivity.

Uncertainty in *M* is not carried through to the assessment outputs because it is fixed in the recommended model. The Team appreciated the sensitivities to catch projections with a fixed *M* or estimating *M*. In particular, the probability of being below $B_{35\%}$ was helpful to understand risk.

The authors recommended Model 23.1.0.d with no reductions from the maximum permissible ABC. The Team agreed with the author's recommendation and had the following additional recommendation:

- **The Team recommended expanding the discussion of uncertainty around *M* in the risk table. For example, the interplay between *M* and *q*, and what may elevate the risk to a level 2 categorization**.

## Aleutian Islands Pacific cod (Operational Full)

Ingrid Spies presented on Aleutian Islands (AI) Pacific cod. This stock is on an annual schedule and an operational full assessment was presented this year. The models presented in the November 2023 document were:

- Tier 5 model (base model): no changes to the input data from 2022 and use of the rema framework to implement the random effects model (which resulted in a 1 t difference in predicted biomass in 2024 and 2025)
- Tier 3 models (alternative models): all include a single fishery with combined catch data, survey age and length data input as conditional age-at-length, bootstrapped input sample sizes and logistic survey and fishery selectivity (unless otherwise specified). Further details include:
    - Model 23.0: three time blocks on the von Bertalanffy growth coefficient (*k*) and breakpoints at 2003 and 2017 to reflect changes in patterns of growth seen in the timeseries
    - Model 23.1: same as Model 23.0 with the addition of five time blocks on fishery selectivity at breakpoints of 2002, 2012, 2016, and 2019
    - Model 23.2: similar to Model 23.0 but with only two time blocks on the von Bertalanffy growth coefficient (*k*) with a breakpoint at 2003 and two time blocks on natural mortality (*M*) with a breakpoint at 2015 to reflect potential marine heat wave (MHW) effects on mortality.

These models fit the survey index and length composition data well, achieved acceptable retrospective patterns, and improved upon the models presented in November 2022 and September 2023.

The model numbers presented in the November 2023 document, although the same as those used in the September 2023 document, did not refer to the same models. Model 23.0 from September 2023 did not use time varying selectivity for the survey or fishery, Model 23.1 used annually varying fishery selectivity, Model 23.2 incorporated the longline survey, Model 23.3 used time varying growth similar to the eastern Bering Sea model. **The Team recommended that authors refrain from reusing model numbers previously reviewed and provide unique model numbers for any new model configurations up for review by the Team**. The September 2023 document provided information on the limitations of the Pacific cod models for estimating *M* and proposed coordinating with the authors of the EBS and GOA Pacific cod models to determine whether to fix *M* or apply a tight prior in future models. The author stated that they had examined the *M* estimates in the models presented and they appeared to be reasonably well-estimated with little variation from previous model explorations suggesting to them that the data for this stock were informative and that fixing *M* was not required.

The presentation included an adjustment to the November Model 23.2 (hereafter referenced as Model 23.2 with adjusted projection) that used a different set of reference years for running the projection model than was provided in the November 2023 document. The new reference years were 2004-2023 and represent years following the first growth time block. The revised model presentation that was provided during the meeting included information on three alternative sets of reference years for the projection model 1) projection based on the mean growth and mortality from the most recent timeblock (2017-present) to include the MHW years, 2) projection based on the mean growth and mortality values for the most recent two decades (2004 - 2023), and a third projection with the mean growth and mortality values across the entire time-series (1991-2023). The Team discussed that the three alternative projections were useful for discussion and reflect difficulties with setting recommendations in non-stationary climate conditions. The Team also noted there is presently a lack of clear guidance on which of the three projections to use, though the Team historically has recommended using long-term averages when estimating reference points. The author recommended the "middle" projection, based on the mean growth and mortality values for 2004 - 2023.

Questions by the Team predominantly centered around the author's presentation on decisions pertinent to the projection of time varying parameters not provided in the document and the differences between the September and November 2023 models. Additionally, the Team asked the author if there were shifts in weight instead of length as the author noted there was not sufficient evidence for the second breakpoint for time varying growth (2017) in Models 23.0 and 23.1. The author had not looked into this yet. The Team asked about the stock distribution across the AI areas as there may be lower productivity or higher mortality in areas with warmer ocean conditions. The Team asked about the parameterization of $M$ and growth time blocks as there was a base parameter and deviation parameters for each time block. It was noted that for both these instances the model could achieve improved parsimony by parameterizing it with a single main parameter for the initial time block and a deviation from that for any subsequent time blocks, reducing the number of parameters by 1 for each time-varying parameter set.

Sensitivities of survey catchability ($q$) were done by using the analytical calculation of $q$ in the assessment and eliminating the prior. The Team noted that although the value of $q$ was nearly the same, other model parameters and results changed considerably. The Team asked about the different direction of trends in the projected ABC and OFL for Model 23.2 with adjusted projection. A member of the public noted that there was very little difference between growth parameters in the two time blocks in Model 23.2 with adjusted projection. The Team asked if an $M$=0.49 has been estimated for Pacific cod. The author said it was within the range of other Pacific cod stocks. The Team noted that the range of $M$ in literature was very large. The Team asked if there might be a fecundity concern given the change in weight or condition in the most recent time block. The author stated there could be but that was not included in the model or assessment this year. The Team asked about the shift in $M$ and if the new $M$ should be used in the Tier 5 model calculation as well. The author did not support the use of the Tier 5 model but if it were used, then they would recommend lowering the ABC using the Tier 3 model based on the population dynamics concerns reported in the risk table. The author noted Model 23.2 estimates the stock to have been at $B_{23\%}$ in 2023 and near $B_{30\%}$ in the other two Tier 3 models presented. All of the Tier 3 models have positive retrospective bias, more so in the two models with higher status, suggesting that they tend to present a more optimistic estimate of stock's current state.

The Team asked about the decline in the fishery CPUE in recent years and if that was a timing issue. Several members of the public responded by providing comments on the effects of management on fishing Pacific cod in the AI. The implementation of the A80 fleet changed the structure of the fishery, treating AI as a separate stock had an effect on when the area is fished, and closures for Steller sea lion management have also had effects. Closures in the eastern Bering Sea, processing limitations in the AI, and sea state conditions during fall also contribute to spatial shifts in the fleet and fishing during less desirable times of the year resulting in reduced CPUE.

The Team discussion centered around insufficient review time for a new model and projection alternatives provided during the presentation, the potential for time-varying length-weight relationships to influence the estimated *M* parameter (as a fixed length-weight relationship is used and empirical annual weight at age data is not available for this stock), and guidance for how to select reference years for periods of low productivity. The Team noted that the 2022 survey index is at the lowest value in the time-series and follows two of the highest values since 2001. Due to the lack of a 2020 survey, the low and relatively precise 2022 survey value is highly influential in the estimation of the current status of the stock. This highlights the need for continued and consistent surveys in the Aleutian Islands to assess the status of this stock. The Team further discussed the length-weight regression component that is not time-varying and that there are more weight-at-length data available than length- or weight-at-age data. **The Team recommended that the authors investigate length-weight data and look for changes over time.** If any are identified, the authors should consider incorporating this in the assessment to explain observed changes in condition of Pacific cod which may not be reflected by length-at-age. Additionally, the Team noted that there may be a confounding interaction between *M*, growth, and fish condition. The Team requested the authors present the available conditional age-at-length diagnostics and the implied fit to the survey age composition data which, although included in the data, the fits to the age composition data were not included in the model likelihood. The author presented these to the Team and the fits for both components appeared to be well behaved.

The Team discussed concerns related to the estimate of *M* in Model 23.2 with adjusted projection. The assessment provides reasonable estimates of *M* without a prior, however the Team questioned the veracity of these results given the poor performance of similar models with more complete data sets in fitting *M* for the eastern Bering Sea stock of Pacific cod. If model assumptions and parameterizations change in the future, estimates of *M* may change as well. Including a prior on *M* may stabilize such behavior. **The Team also recommended that a sensitivity analysis on *M* similar to what was provided in the eastern Bering sea Pacific cod assessment be presented given the high uncertainty in that value.** A sensitivity analysis on *M* would be helpful to understand the risk of overfishing, data sources influencing *M* estimates, and correlation between *M* and other model parameters, including growth parameters and survey catchability. Projections with the age-structured model were provided, but it was unclear what values of *M* and *k* were used in the projection provided in the document. The authors described that they investigated different time-periods for these parameters and the differences in catch advice was large; however, this analysis was not included in the document and therefore not available for review prior to the presentation. The Team discussed the need for a Plan Team or Council working group focused on methods to determine catch advice and projections given productivity shifts and time-varying parameters and best practices or guidance on potential sensitivity evaluations that authors might consider including when faced with non-stationarity in model parameters that influence harvest projections. The Team also suggested several upcoming workshops to develop best practices regarding these methods (e.g., council CCTF in the spring 2024, SSC workshop in summer, and National SCS8). Nevertheless, the assumptions used for time-varying parameters (both annually-varying or time-blocked) when projecting the stock should be clearly described in the assessment document. The Team agreed that Model 23.2 with adjusted projection had potential, but the Team needed adequate time to review and there were remaining questions on the calculation of OFL.

The authors recommended Model 23.2 from the November 2023 document with the adjustment of using the reference years 2004-2023 as provided in the presentation to the Plan Team, which resulted in an ABC recommendation of 10,660 t for 2024 instead of the ABC recommendation of 3,655 t presented in the November 2023 document. The authors recommended no reduction from maximum ABC.

The Team appreciated the time and effort the authors put into developing the models presented in this stock assessment. However, given how divergent the author recommended model (Model 23.2) was from the models presented in September 2023, the Team determined that Model 23.2 required additional review before it could be accepted for management. As the Team was only provided the projection

choices and the resulting change in specifications during the author's presentation, the Team was unprepared to make a final decision and set precedence on the most appropriate method given the lack of documentation on the matter. The author provided sufficient justification that Models 23.0 and 23.1 were not viable for management purposes. Therefore, the Team recommended continued use of the base Tier 5 model with a reduction from maximum ABC due to the Level 2 - Major Concerns in the risk table for the population dynamics and ecosystem considerations sections. Both the trawl and longline survey indices and fishery CPUE are at their lowest in the time series and there continues to be sustained warm temperatures at the surface and bottom in the AI. The reduction from the Tier 5 maximum ABC is set equal to that which would match the ABC to the 2024 OFL from the author recommended model (Model 23.2 with adjusted projection) projected using the mean *M* and growth values for 2004-2023 as presented on slide 39 of the authors presentation to the Team. This reduction was intended to reduce the probability that the ABC exceeds the true but unknown OFL, per SSC recommendation. The reasoning behind this decision mirrors that employed in 2022 in reducing the ABC from the maximum for BSAI northern rock sole when the Team was faced with a compelling, but not adequately reviewed, new model and indications from the risk table of potential cause for concern. The Team recommended the use of the projected OFL from the model in 2024 for both 2024-2025 due to unresolved questions regarding the conflicting trends of the increase in OFL as compared to the static projected ABC from the model in 2025.

Additional recommendations from the Plan Team include:

- **The Team recommended that the authors conduct a sensitivity analysis and provide the probability of being under $B_{20\%}$ given the three projection scenarios similar to what was provided in the eastern Bering Sea Pacific cod stock assessment.**

## Yellowfin sole (Operational Full)

Ingrid Spies presented two models, 22.1 and 23.0 for the operational full assessment of the BSAI yellowfin sole stock. Model 23.0 is based on Model 22.1, except that a single sex time-varying fishery selectivity was used rather than separate time-varying fishery selectivities for males and females. Model runs among 2022 22.1, 2023 22.1, and 2023 23.0 were compared and summary tables are similar, with a slight reduction in OFL and ABC resulting from model 23.0 compared to those from Model 22.1. The author recommended Model 23.0 because it had similar results with improved parsimony. There were no concerns for assessment and fishery performance, and major concerns for population dynamics and environmental ecosystem considerations.

A member of the Team asked about the difference in 2023 catch in Table 1 and Table 2. It was determined that this difference, approximately 20,000 t, was due to downloading the catches on different dates; October 20, 2023 (Table 1) and October 30, 2023 (Table2).

The Team asked whether a sensitivity analysis had been conducted to understand the effects of using a fixed natural mortality (*M)* for females and an estimated *M* for males. The author responded that they have not attempted to estimate female natural mortality and they had not conducted a sensitivity analysis or profile over female natural morality in this set of models. They did state that such an analysis could be explored in next year's assessment.

The Team also asked why population dynamics in the risk table are considered a major concern if the population is above $B_{MSY}$ and there are indications of recent large recruitments, even while recognizing that the estimated biomass is at the second lowest level on record. The author conceded that the level of concern for population dynamics considerations could be debated, but thought there is major concern based on the considerable (48%) drop in estimated biomass between last year's and this year's assessment.

In addition to questions for the assessment author, the Team asked industry representatives if they had any thoughts or input on the yellowfin sole assessment and trends in the fishery and global markets. Industry representatives stated that the domestic and global demand for yellowfin sole is down, partly due, in their opinion, to Russia flooding the flatfish market. Specifically, catches in 2023 were strong until June, then declined considerably because of the lower demand, shifting markets, market disruptions and a variety of other factors. These disruptions resulted in a decline in price that hurt profits and ultimately changed fishery dynamics. From the industry perspective, yellowfin sole fishery dynamics were not affected by the availability of fish, but rather market considerations. Moving forward, there is hope to develop new markets, including different modes of processing and selling yellowfin sole products.

The author recommended Model 23.0 with no reductions from maximum permissible ABC.

The Team agreed with the author's recommendation and had the following additional recommendations:

- **The Team recommended that the author conduct a model sensitivity analysis to evaluate the current approach used for natural mortality and the effect it has on model performance and results.**

## Northern rockfish (Operational Update)

Paul Spencer presented the operational update assessment for the northern rockfish stock. The 2023 model run includes updated data and updating the ageing error matrix. The author noted that the 2023 catches are the highest on record and targeting appears to be increasing. A team member noted that targeting can be a factor of management actions as well as biomass, in particular, there can be instances when the fleet is trying to avoid the species but may not be able to. While the model was not changed, there was some change to the results. The author thought that the change in the result was approximately equally attributable to the new 2022 survey biomass estimate, and the updated age/length composition data and that the updated ageing error matrix had very little effect on the model, and had only a minor effect on the pattern of estimated recruitment.

Updating the ageing error matrix broadened the curve around the true age. The Team asked if the changes in recruitment a result of the changes in the ageing error matrix could be. The author felt that it most likely did. The Team asked if there was a retrospective analysis conducted on natural mortality. The author noted that he completed a likelihood profile on natural mortality and a retrospective analysis, but had not examined the behavior of natural mortality in the retrospective analysis specifically. This could be done next year. The Team asked if the mismatches between the modeled and survey age compositions are a result of fishery behavior. The author noted that there may be an interaction with the plus group as well and that not all years are weighted equally (a function of input sample size).

The author recommended Model 21 with no reductions from maximum permissible ABC.
The Team agreed with the author's recommendation and had no additional recommendations.

## Skates (Operational Update)

Cindy Tribuzio presented the operational assessment of the BSAI skate complex, which includes the Alaska skate component, assessed as a Tier 3 stock, and the “other skates” component, assessed as a Tier 5 stock. This assessment underwent a change in authorship for this assessment cycle, and the authors’ approach was to change nothing of note in the methodology and run the previously accepted model on an upgraded modeling software version, with new or updated data. In the recommended Tier 3 Alaska skate model (14.2d), the longline fishery selectivity changed to dome-shaped from asymptotic. Since the only changes to the assessment were a) changes to the input data, including adding new data and slight

corrections from past data; and b) a switch to a new modeling software version, the Team noted that this change in selectivity was most likely related to the Stock Synthesis version change, recalling that a different stock assessment author had noted this same behavior last year for a different stock assessment.

The Team noted that BSAI Alaska skates are the only age-structured assessment for groundfish in Alaska that do not include marginal age composition data. The primary aging structures for skates are vertebrae, and there are several years of survey age data available (2003, 2007, 2008, 2009, and 2015). The Team wondered if this collection would happen again, since the absence of the samples moving forward will increase uncertainty in this Tier 3 assessment in the future. The cessation of sample collection may continue in the near term since it is time-intensive for AFSC Age and Growth Lab staff to age skate vertebrae, and also for survey biologists and fishery observers to collect the vertebrae at-sea. It was noted by AFSC Age and Growth Lab staff that whether this collection and ageing continues depends on age reading prioritization and staffing availability.

For the "other skates" component of the stock, assessed as Tier 5, the Team asked the author how they thought about using a combined fixed natural mortality value of 0.10 for all the species in that group. The author responded that the combined value is likely incorrect, and that it is one of the first things they will tackle for the next assessment cycle.

A Team member noted that the biomass estimates for the Tier 3 Alaska skate component of the stock appears to be overestimated during the colder years and underestimated during the warmer years. Survey catchability is fixed at 1.0 in the model. **The Team recommends the authors examine using a catchability that is tuned to temperature.** In terms of other next steps for improving the assessment, the lead author expressed a desire to generally "clean things up". This includes but is not limited to the following:

- Make the assessment code clear, documented, and reproducible.
- Focus on tuning the data and model inputs.
- Examine deriving a different value of *M* for each of the Tier 5 "other skate" species.
- Determine whether to include the northern Bering Sea (NBS) survey in the assessment. NBS survey data indicate that Alaska Skate is abundant in the region.

The Team applauded the authors' approach to not change the methodology for this first assessment cycle after the change in authorship and gave the authors leeway to explore the data and assessment methodology in more detail to come up with the improvements that should be incorporated into the model for the next assessment cycle. The Team commended this careful and considered approach and would like to see it be used for how authorship transfers be conducted going forward.

The author recommended Model 14.2d with no reductions from maximum permissible ABC.
The Team agreed with the author's recommendation and had no additional recommendations.

## Octopus (Operational Update)

Lee Cronin Fine presented the operational updated assessment for BSAI Octopus stock complex. No alternatives models were considered but new Pacific cod stomach data were used to update the 2016 consumption estimate of total natural mortality from Pacific cod diet data. This resulted in an increased value for natural mortality (*M*) from the previous 2016 estimate leading to an increase in ABC and OFL. Updated survey data were provided but are not employed in the assessment due to concerns with the inaccuracy of the survey data in estimating the octopus stock complex.

The Team asked if the method for estimating predation/consumption has changed at all. The author indicated that it has not, the method has been consistent since 2012. A member of the public asked how the diet data were expanded to the entire Pacific cod population. The author indicated that it is an approximation based on the weight and proportion of stomachs sampled that include octopus. Estimates are calculated by length strata of Pacific cod and by the proportional survey biomass in eight area strata, this method is more conservative than using assessment estimated biomass. The Team discussed the possibility of updating these estimates using a VAST approach to improve spatial resolution. The Team noted that an increase of octopus in Pacific cod diets could be a result of increases in octopus or in Pacific cod in the area.

**The Team recommends that the next assessment contain a link to the original consumption methodology employed in the 2012 analysis.**

The Team thanks the new assessment author for their operational update assessment and agrees with the recommended OFL and ABC from the author.

## Harvest Projections

Melissa Haltuch presented harvest projections.

For blackspotted/rougheye rockfish the Team discussed the continued spatial management concerns with this stock and the lack of sufficient tools (MSSC) to address this. The Team reiterates concerns about the differential exploitation of this stock noting that there may be demographic differences across spatial scales regardless of recent indications of a lack of genetic structure. The Team looks forward to a full assessment in 2024 that may incorporate any additional information since the previous assessment.

**The Team was concerned about the status of Greenland turbot and recommended an operational full assessment due to concerns with continued long-term declines in survey indices as well as the inability of the model to fit the indices.** As per the SSCs December 2022 minutes a number of recommendations to improve the stock assessment have been identified by the authors, the Team, and SSC in this assessment and in the past. These include the treatment of estimates of length-at-50% maturity (currently fixed at 60 cm, and uncertainty not accounted for) and estimates of trawl survey catchability (also currently fixed in model) to assess their impacts on model fits. In the 2022 review the Team also recommended that the authors revise the interpolation method used to combine the EBS and AI longline survey relative population numbers, continue exploration of killer whale depredation impacts on longline survey abundance estimates, and present newly available sex-structured length data from the longline survey. The Team looks forward to the authors investigating and reporting on these in the 2024 full operational assessment.

**The Team recommended that a bullet point be added in harvest projection presentations to explain reductions or changes from maximum ABC when it occurs.**

## Multi-species model

Kirstin Holsman presented the results of the CEATTLE climate-informed multi-species model for Bering Sea walleye pollock, Pacific cod, and arrowtooth flounder. Two versions of the model, with and without trophic interactions (single-species mode and multi-species mode), have been run every year since 2016. Updates to this year's model included inputs of 2023 survey biomass, catch, age/length compositions, and ROMS bottom temperatures, and the document has been reorganized to include more information on the recruitment and temperature-specific weight-at-age components. While model results are not currently used directly to generate harvest specifications, a number of outputs are produced that can help inform traditional stock assessments, ESPs, and ESRs, including estimates and sources of age-1 natural mortality, annual predation indices, annual age-related consumption rates, biomass, and recruitment. Climate-informed probabilities of future increases or decreases in biomass (1-2 year, 10 year, and 30 year projections) under different warming scenarios are also provided as a risk assessment.

A Team member asked if model results are provided to assessment authors when they are writing their risk tables. The author replied that this is usually the goal but was prevented by extenuating circumstances this year. There was some discussion on how to decide what information would be most beneficial for assessment and ESP authors to receive early. The author emphasized that she is happy to provide outputs that would be useful to authors and for Team discussion. **The author intends to communicate with stock assessment authors earlier in next year's assessment cycle to help facilitate risk assessment, which is further recommended by the Team.** A member of the public asked to what extent the CEATTLE temperature-driven weight-at-age would be helpful to understand trends in the pollock stock assessment. The author noted that trends are consistent between CEATTLE and the assessment, and the assessment author stated that a direct comparison would be worthwhile, though fleet dynamics could cause patterns not influenced by the environment, which are not accounted for in the CEATTLE model. Finally, a Team member asked how this work will be integrated with the NOAA Climate, Ecosystems, and Fisheries Initiative (CEFI). The author stated that her team will be getting more resources from CEFI to improve the model, including evaluation of the new MOM6 model (more information available at https://www.gfdl.noaa.gov/mom-ocean-model/), which if it performs well, will be used operationally by 2026/2027. The Team noted that this information is also highly useful to ESPs and the author agreed and encouraged anyone who uses model-based indices to coordinate directly with ROMSNPZ or MOM6 index authors to understand limitations of the dataset.

## BSAI Sculpins (Ecosystem Component)

Ingrid Spies presented an updated review of the assessment of sculpin trends, biomass, and incidental catch in the Bering Sea and GOA. In 2020 sculpins were reclassified as an ecosystem component category. There is currently no directed harvest and incidental harvest remains low. For reference the author provided the OFL and ABC values based on the previous Tier 5 assessment methods, but these are for reference only (not used to determine harvest recommendations or overfishing status as these are not done for ecosystem component species). Through the stock assessment prioritization process, the sculpin report is now on a 4-year cycle, with the next report expected in 2027. The author showed that the current catch rates are an order of magnitude lower than the OFL. The author finds no concern with the harvest rates for sculpin and the Team agrees. There was some discussion regarding trends over time and no apparent climate or long-term trend has emerged, although some species biomass is increasing while others are decreasing slightly. The Team appreciates having the information on the OFL (perhaps in a format that helps clarify that the numbers are for reference not management action).

## Forage Fish (Ecosystem Considerations)

Cody Szuwalski provided the forage fish report. This report is done on a biennial basis. Some specific noted trends include the highest density and prevalence of herring in the time series of the survey with fishery catches of squid and herring very high compared to historic levels. There was also continued low prevalence of capelin and eulachon in the eastern Bering Sea shelf bottom trawl survey. The Team appreciated the inclusion of the new maps by forage species over time and the use of the prevalence metric and standard reporting. Some suggestions included to have a smoother (REMA, GAMs or other methods) to apply to trend information as well as to consider whether maps of herring distribution could be helpful in informing future management considerations of herring savings areas. The author indicated that it's not clear yet to what extent these herring densities would be appropriate for informing management actions. Questions were posed as to coordination or consideration of Alaska Department of Fish and Game herring assessment information compared with distributional AFSC survey and BASIS mapping. The author indicated that this could be considered in future iterations of the report. The Team was very complimentary of the report and looks forward to future iterations as well as results of the authors planned research considerations as noted in the presentation.

Recommendations from the Team include the following:

- **The Team recommended providing some indication on future plots of reference levels across years to show consistent comparative information across years and trends.**
- **The Team recommended working in collaboration with the ESR team and to consider how to contribute forage information to other initiatives such as ESP and ESR as time allows including the consideration of what is the best index of forage and how and where it can be reported on an annual basis.**